Content

Section 19
Uintah Basin Plan

Groundwater

Groundwater is a source of water for municipal, industrial and agricultural uses in the Uintah Basin.

19.1 Introduction

Groundwater occurs in underground aquifers that are hidden from view. The boundaries of an aquifer are physical, thus they may outcrop, i.e., be offset by faulting against an impermeable rock unit. Aquifers may grade laterally into a lower permeability deposit due to changes in the depositional environment, or they may thin and disappear. At any given location, the land surface may be underlain by several aquifers. Each aquifer may have different chemical quality and different hydraulic potential. Each aquifer may be recharged in a different location and may flow in a different direction. Groundwater divides do not necessarily coincide with surface water divides. These unique conditions demonstrate that the development and management of groundwater is more complicated than that of surface water.

Groundwater in the Uintah Basin has been developed for use as public water supplies, irrigation water and stock watering. Springs were the first method developed to access underground water, followed by wells.

19.2 Aquifer Characteristics

Unconsolidated, valley-fill materials have traditionally been the best producers of groundwater in Utah. About 98 percent of the wells in Utah are completed in unconsolidated deposits. In the Uintah Basin, however, the occurrence of unconsolidated deposits is limited. The unconsolidated deposits, where present, are composed of alluvium, colluvium and glacial deposits of morainal and outwash origin. The most extensive unconsolidated aquifers are found in the Duchesne-Myton-Pleasant Valley area[76] and the plain east of Neola.[51] In most other areas, the unconsolidated aquifers are found in the bottoms of mountain canyons, in stream valleys and as discontinuous caps on terraces. These deposits are rarely more than 50 to 70 feet thick. Wells and springs in these deposits are found to yield from small to very large amounts -- less than 10 to greater than 1,000 gpm -- but few wells yield more than 1 cfs.[76,51]

Due to the lack of unconsolidated aquifers in much of this basin, the only other groundwater source that can be developed is from consolidated or bedrock aquifers. While all geologic formations contain some water, those in the Uintah Basin which have been identified as being the best groundwater targets are the Browns Park, Duchesne River, Uinta, Current Creek and Morgan formations, Nugget/Navajo sandstone and Weber quartzite. These consolidated aquifers are considered the best for development.

Groundwater in these consolidated formations is unconfined in locations nearest areas of recharge. Confined conditions, however, are the most common and occur in about 90 percent of the area within the basin underlain by sedimentary rocks.[55]

The circulation of groundwater in these consolidated aquifers is affected by folding and faulting, which locally will either enhance groundwater movement by fracturing or impair groundwater movement by offsetting aquifers. Local fracturing also enhances interformational leakage, which affects water quality.

19.3 Groundwater Budget

Aquifers lose water from storage, referred to as discharge, through evapotranspiration, discharge at springs and seeps, subsurface outflow, and through well production. Aquifers receive additional water, referred to as recharge, through infiltration of surface water in the form of rain, snow melt, and/or streamflow and irrigation in recharge areas and by subsurface inflow. The downward percolation of water from these sources into and through bedrock layers replenishes the aquifers.

Previous studies have shown that an average annual groundwater budget, including all sources of recharge and discharge to and from the aquifers of the Uintah Basin, have been about 630,000 acre-feet. The groundwater budget is summarized in Table 19-1.

19.3.1 Precipitation

The Uintah Basin aquifers, consolidated and unconsolidated, rely in large part on precipitation for their recharge. The majority of this basin receives less than 16 inches of precipitation per year (see Figure 3-4). Only the higher elevations in the western and northern areas of the basin, i.e., the Uinta Mountains and the area around Strawberry Reservoir, receive upwards of 20 to 40 inches of annual precipitation. Limited precipitation, particularly in the areas of outcropping aquifer host rock, results in limited infiltration and recharge.

The average annual volume of precipitation that fell on the hydrologic Uinta Basin (not including the north slope) during the period 1941-1970 is estimated to be about 8 million acre-feet. An estimated 600,000 acre-feet (7.8 percent of this total)[55,76] has infiltrated annually to recharge the groundwater aquifers.

19.3.2 Recharge and Discharge

Recharge to the consolidated bedrock aquifers is by several methods. Among them are the infiltration of precipitation directly into the fractured bedrock outcrops or into the aquifer from overlying, saturated unconsolidated deposits; the upward leakage of groundwater from underlying formations; the downward leakage of groundwater from overlying formations; the seepage into the aquifers from streams flowing across outcrops, where the water table is lower than the streambed, and by infiltration of irrigation water; and the recharge which occurs from the inflow of groundwater that originates outside the area but flows into the basin.

Recharge to the unconfined alluvial aquifer is supplemented by irrigation and return flow. Evidence that this occurs, at least locally, is the observation that the water level in alluvial wells responds to the application of water during the irrigation season.

Discharge of groundwater from the consolidated bedrock aquifers occurs at springs and seeps, including seepage into streambeds, through wells, by evapotranspiration, by upward leakage into the overlying formations and by downward leakage into underlying formations. Small groundwater flows also leave the basin by subsurface flow into neighboring basins.

The total annual estimated recharge of 630,000 acre-feet is divided between infiltration of precipitation which accounts for about 600,000 acre-feet per year of the total recharge and infiltration of irrigation water which adds about 20,000 acre-feet per year, while return flow from wells and springs accounts for the remaining 10,000 acre-feet per year. It has been observed that about 80 percent of the total recharge takes place in the northern half of the Uintah Basin. This is primarily due to the fact that more water, particularly in the form of precipitation, is available to enhance the recharge in the Uinta Mountains than is available to the much lower upland areas at the southern edge of the basin.

The total annual estimated discharge of 630,000 acre-feet is divided between evapotranspiration in phreatophyte areas which accounts for 246,000 acre-feet, seepage to streams and discharge to springs which combined accounts for 363,000 acre-feet, and well withdrawal which is estimated to account for the remaining 21,000 acre-feet. Subsurface inflow and outflow in the Uintah Basin is considered to be negligible.

19.3.3 Groundwater Storage

Based on previous studies, an estimated 31 million acre-feet of water is in storage in the basin's aquifers. This volume is only in the upper 100 feet of saturated material and is figured without regard to water quality.

19.3.4 Springs and Wells

Figure 19-1 locates existing springs, and Figure 19-2 locates existing wells in the basin.

19.4 Water Quality

Groundwater in the Uintah Basin aquifers ranges from fresh (less than 500 milligrams per liter of dissolved solids) to briny (more than 35,000 milligrams per liter of dissolved solids). This is shown in Table 19-2. The freshest water is found in the Precambrian rocks of the Uinta Mountains. For each aquifer, the water is freshest in the recharge area. Then as it moves down gradient it becomes more saline as it dissolves soluble minerals. The total dissolved solids of the entire basin range between 25 mg/l in the Uinta Mountain Group and 178,200 mg/l found in the brines of the Green River Formation.[80] The overall chemistry of the groundwater changes as it moves from higher recharge areas toward the deeper central part of the basin. This trend is marked by the following changes. Initial water infiltrating in recharge areas is most commonly of the calcium-magnesium-bicarbonate type. As it begins its descent into deeper regions of the aquifer, it becomes a sodium bicarbonate type, then changes to a sodium sulfate, and finally becomes a type dominated by sodium chloride. This process, which is characteristic of most deep groundwater basins, is enhanced in the Uintah Basin by the presence in some formations of unusual salts. Among these are Nahcolite (sodium bicarbonate) and trona (hydrated sodium carbonate and sodium bicarbonate).[80,48]

19.5 Groundwater Management

The most easily developed and most productive source of groundwater for future needs is the glacial outwash and related coarse-grained unconsolidated deposits that underlie the flood plains of the Green, White and Duchesne rivers, the terraces and outwash plains (as near Neola), and the Ashley Valley area. Five major consolidated aquifers -- the Duchesne River, Uinta and Currant Creek formations, the Glen Canyon (Nugget) sandstone and the Weber quartzite -- are all relatively undeveloped, and withdrawals from them have not depleted storage. The Weber and the Glen Canyon formations are the most promising for large yields of fresh to slightly saline water.

19.5.1 Present Groundwater Use

Development of the groundwater resources in the Uintah Basin has been minor. This is due to several reasons: 1) The early development of surface water has been adequate for most needs; 2) the consolidated aquifers, generally, have hydraulic properties that preclude large-scale groundwater development; 3) the quality of the groundwater in some parts of the area is unsuitable for domestic, municipal and/or agricultural uses; and 4) the economics of drilling and pumping water from deeply buried aquifers is prohibitive.

The average annual discharge from wells for domestic and industrial use is 21,060 acre-feet, as shown in Table 19-3.

19.5.2 Groundwater Management Plan

A management plan, including data collection, groundwater modeling and analysis, is needed to facilitate development in areas where surface water is not available. Fruitland is one of these areas.

19.6 Problems and Alternatives

19.6.1 Selenium Contamination

The selenium problem at Stewart Lake Waterfowl Management Area, Lower Ashley Creek, Ouray National Wildlife Refuge and Pariette Wetlands should be resolved. At present, the Bureau of Reclamation and the USGS are studying the problem, and alternative solutions will be suggested. The problem is the groundwater flow into these areas.

19.6.2 Shallow Wells Drying Up

The more efficient use of canal lining and sprinkler systems has reduced the water lost to leaking canals and return flows. This reduction in groundwater has decreased or dried up shallow wells. Shallow wells are wells drilled to less than 100 feet deep. ❑

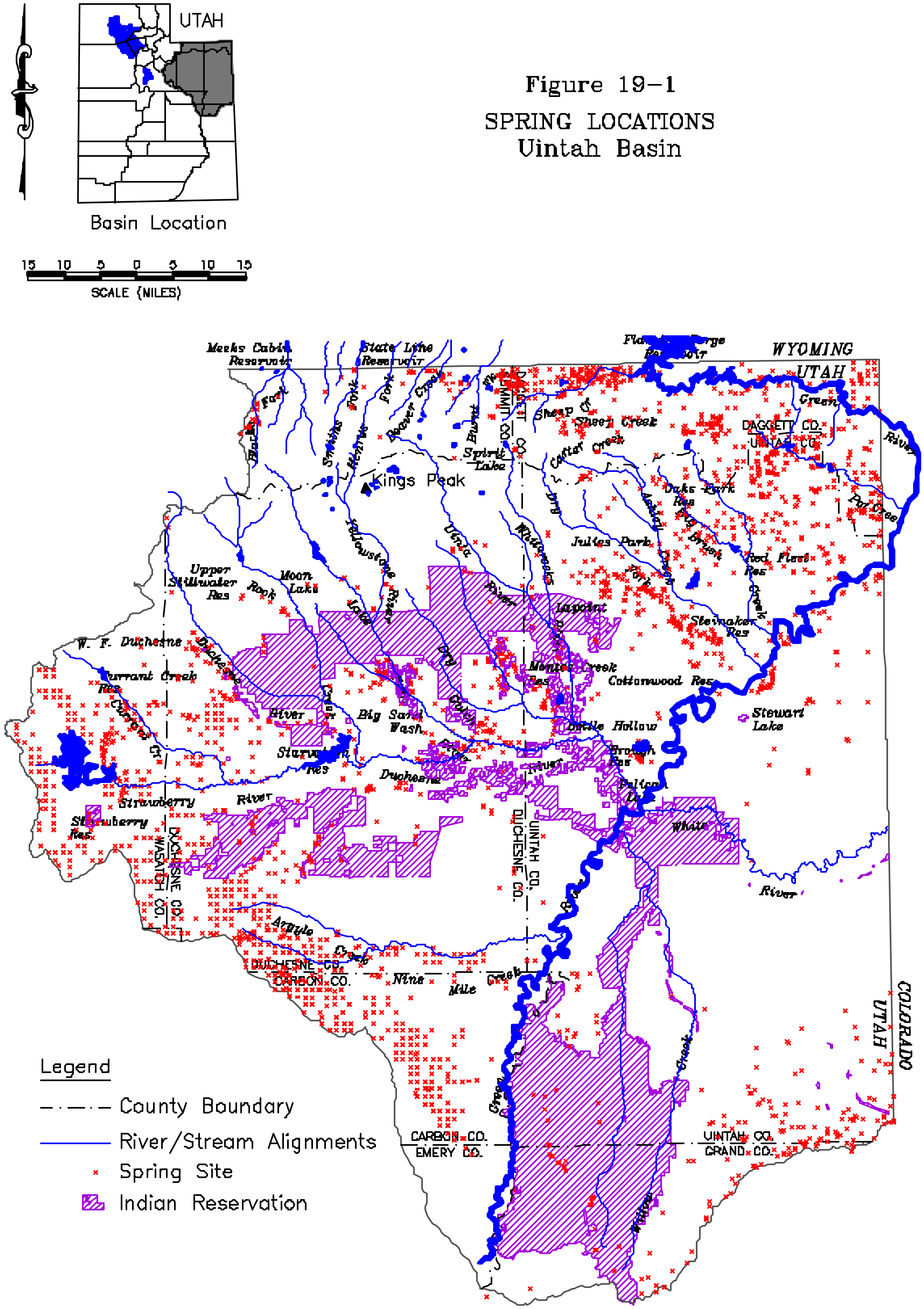
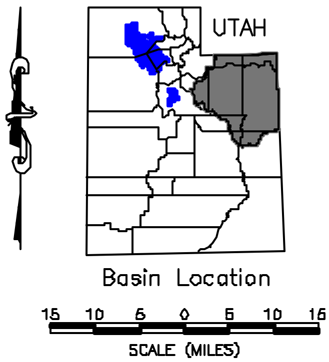


Figure 19-1
SPRING LOCATIONS
Uintah Basin

Figure 19-2
WELL LOCATIONS
Uintah Basin



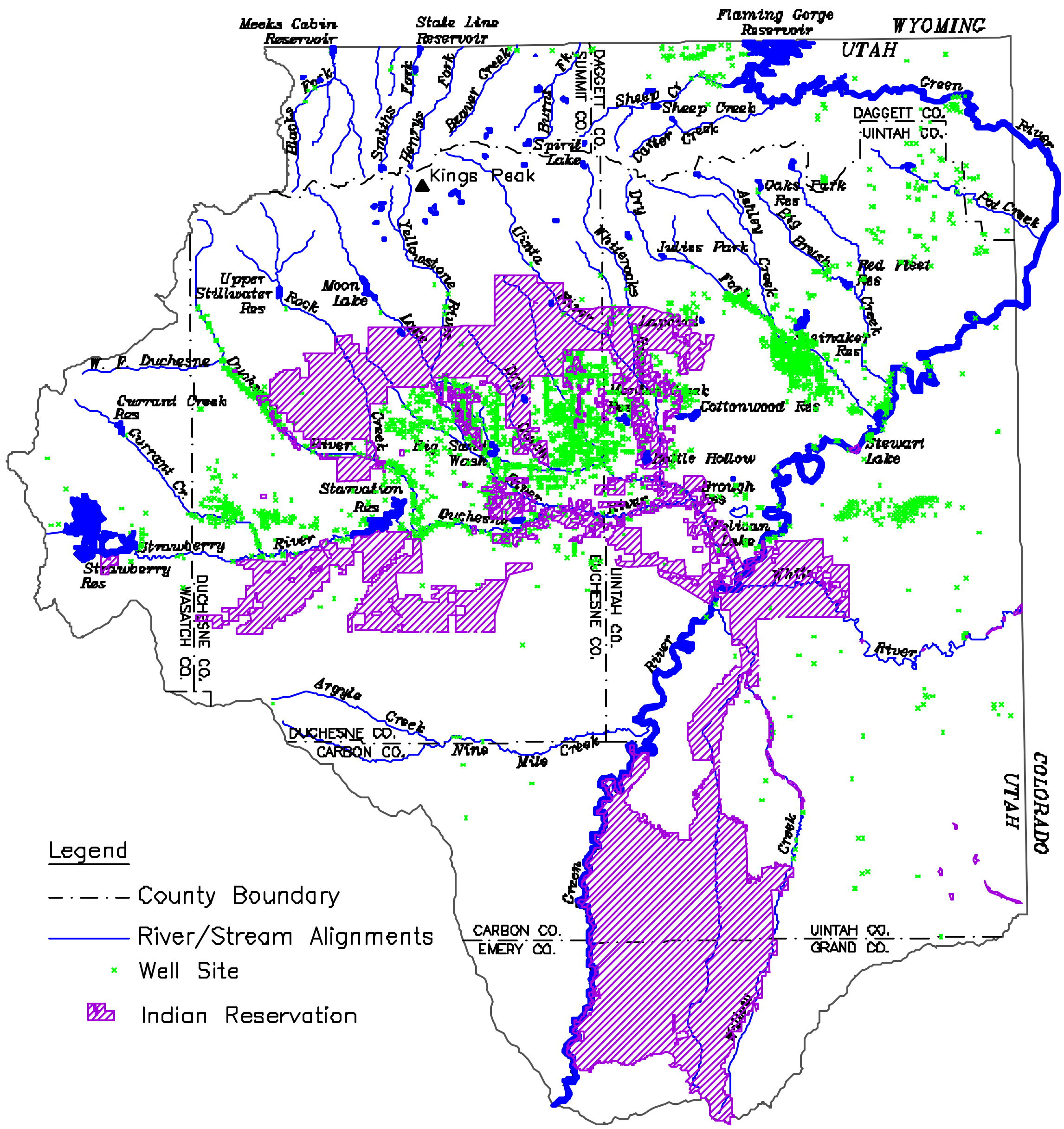


Table 19-1 Groundwater Budget of the Uintah Basin	
Component	Long-Term Average (ac-ft/year)
Recharge	
Precipitation	600,000
Irrigation Water	20,000
Return Flow from Well and Spring Discharge	10,000
Total	630,000
Discharge	
Streams and Springs	363,000
Evapotranspiration	246,000
Withdrawal from Wells and Springs	21,000
Total	630,000

Source: Holmes, W. F., *Water Budget and Ground-Water Occurrence in the Uintah Basin of Utah*, U. S. Geological Survey, in Utah Geological Association Guidebook.

Table 19-2
Total Dissolved Solids By Aquifer (mg/l)

Formation	High	Average	Low
Alluvium	29,900	2,900	260
Fluvialglacial	10,000	1,050	35
Browns Park	310	220	45
Duchesne River	30,800	1,170	85
Uinta	64,300	3,260	160
Currant Creek	640	335	170
Nugget/Navajo	1,870	430	160
Weber Quartzite	118,000	3,215	60
Morgan	185	180	180
Uinta Mountain Group	25	25	25

Source: Schlotthauer, W.E., *Identification and Characteristics of Aquifers in Utah*, Utah Div. of Water Rights, 1981.

Table 19-3
Withdrawals From Wells and Springs

Name	Discharge (ac-ft)
Municipal[a]	10,290
Mining Operations	3,000
Oil Production	770
Power Production	7,000[b]
Total	21,060

[a]Includes small industrial units and secondary water use.
[b]Alluvial wells by the Green River.